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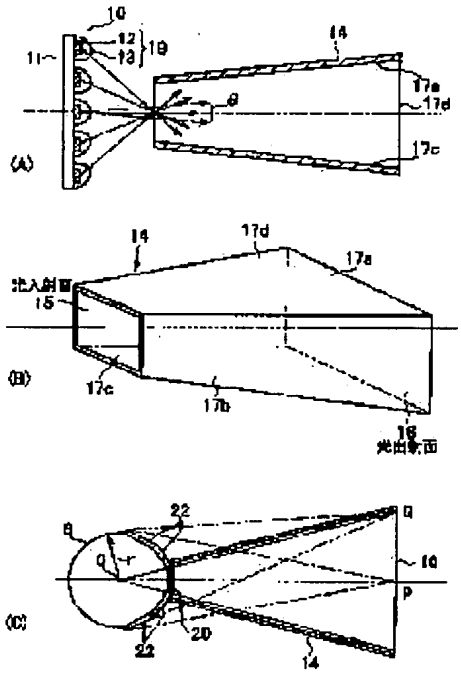
(71)Applicant : TOSHIBA CORP
TOSHIBA AVE CO LTD
(72)Inventor : OBAYASHI TOSHIO
MIHARA HISAYUKI
SAKAMOTO TSUTOMU

(54) ILLUMINATOR FOR PROJECTION TYPE DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain an illuminator capable of more improving the availability of light, reducing power consumption and decreasing heat generation.
SOLUTION: A light guide 14 has a light incident plane 15 and a light- emitting surface 16 whose area is larger than that of the light incident plane. An inside wall surrounding a hollow formed between the light incident plane 15 and the light-emitting surface 16 and forming the hollow has a reflecting property. A light source part 10 is arranged on the side of the light incident plane 15 of the light guide 14, and plural semiconductor light emitting bodies 12 are arrayed, so that the light from the semiconductor light emitting bodies 12 is condensed on the light incident plane 15. Thus, the utilization efficiency of the light is improved more, and also the reduction of the power consumption and the reduction of the heat generation are attained.



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CLAIMS

[Claim(s)]
[Claim 1] The lightguide with which it has optical plane of incidence and the optical outgoing radiation side where area is bigger than this optical plane of incidence, and the wall which encloses the hollow formed between said optical plane of incidence and an optical outgoing radiation side, and forms said hollow has reflexibility, The lighting system of the projection mold display characterized by having the light source components which it has been arranged [components] at said optical plane-of-incidence side, and two or more semi-conductor emitters are arranged [components], and make said optical plane of incidence condense the light from said semi-conductor emitter.
[Claim 2] Said light source component is the lighting system of the projection mold display according to claim 1 characterized by making a crevice counter said optical plane of incidence, and arranging said semi-conductor emitter in this crevice.
[Claim 3] The light which said light source component has said semi-conductor emitter irradiated towards a reflective member, and was reflected by said reflective member is the lighting system of the projection mold display according to claim 1 characterized by going on towards the optical plane of incidence of said lightguide.
[Claim 4] Said light source component is the lighting system of the projection mold display according to claim 1 characterized by having led through auxiliary small lightguide when leading the light from a semi-conductor emitter to the optical plane of incidence of said lightguide.
[Claim 5] Said light source component is the lighting system of the projection mold display according to claim 1 with which the periphery of the array area of two or more of said semi-conductor emitters is characterized by being larger than the periphery of said optical plane of incidence of said lightguide.
[Claim 6] said light source component -- the periphery of the array area of two or more of said semi-conductor emitters -- the periphery of said optical plane of incidence of said lightguide, and abbreviation -- an equal twist -- or the lighting system of the projection mold display according to claim 1 characterized by the small thing.
[Claim 7] The lighting system of the projection mold display according to claim 1 characterized by arranging the condenser lens at said optical outgoing radiation side side of said lightguide.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the projection mold display which projects on a screen the image which illuminates a liquid crystal display panel etc. and is formed in the liquid crystal display panel concerned, and relates especially to the improvement of that lighting system.
[0002]
[Description of the Prior Art] The lighting system which projects on a screen the image formed in a liquid crystal display panel is indicated by for example, the patent No. 2713408 official report. In order that these indicated contents may raise lighting effectiveness (use effectiveness of light), they arrange a viewfinder between a liquid crystal display panel and the light source, reflect light by the hollow inside of a viewfinder, and are led to a liquid crystal panel.
[0003] However, fluorescence tubing as the light source is a source of the white light. When carrying out color display with a liquid crystal panel, a color filter, a dichroic mirror, etc. need to separate a color into the three primary colors (red, green, blue), it is necessary to lead light to a liquid crystal panel, and the light of the wavelength which becomes unnecessary serves as heat. In a color filter, the use effectiveness of light is bad, and components mark increase in a dichroic mirror. Moreover, if the power of fluorescence tubing is raised in order to make it bright, the light of the wavelength which becomes unnecessary will also increase together, and its calorific value will increase, and it will produce fault. For this reason, that configuration is not appropriate when obtaining reduction of power consumption, and oppression of generation of heat. Moreover, when planning much more rate for Mitsutoshi, there is a limitation.
[0004]
[Problem(s) to be Solved by the Invention] In the lighting system which projects on a screen the conventional image which made the above-mentioned fluorescence tubing the light source, there was a limitation also in respect of the use effectiveness of about [that the problem was constitutionally shown in aiming at reduction of power consumption, and oppression of generation of heat], and light.
[0005] Then, this invention aims at offering a low power and the projection mold display which can obtain reduction of generation of heat while it improves efficiency for light utilization further.

[0006]
[Means for Solving the Problem] The lightguide with which the wall which has optical plane of incidence and the optical outgoing radiation side where area is bigger than this optical plane of incidence, encloses the hollow formed between said optical plane of incidence and an optical outgoing radiation side, and forms said hollow in order that this invention may attain the above-mentioned purpose has reflexibility, It is arranged at the liquid crystal display panel arranged at said optical outgoing radiation side side, and said optical plane-of-incidence side. Two or more semi-conductor emitters are arranged, and it has the light source components which make said optical plane of incidence condense the light from said semi-conductor emitter, and is made to irradiate the liquid crystal display panel arranged at said optical outgoing radiation side side.

[0007] In this lighting system, by shining with the above-mentioned light source components, and using a guide, generation of heat by unnecessary wavelength light is reduced, and low-power-ization is attained, and the uniform illumination light is obtained, and efficiency for light utilization can be raised.
[0008]
[Embodiment of the Invention] The gestalt of implementation of this invention is explained with reference to a drawing below.
[0009] Drawing 1 (A) shows the description section of this invention. As for the light source components 10, two or more emitters (light emitting diode) 12 are arranged two-dimensional on one field of a substrate 11. And two or more emitters 12 are covered with the respectively transparent mold member 13. On the drawing, the sign is attached and shown in one group of an emitter 12 and the mold member 13 (this part is called below the light emitting device section 19). In this example, since it is formed so that the outside configuration of the mold member 13 may have the directional characteristics of outgoing radiation light and may have a lens function, the light from the light emitting device section 19 condenses at the core of the optical plane of incidence 15 of lightguide (kaleidoscope) 14.
[0010] In addition, although are arranged the core of a substrate 11, and near the and the luminous-intensity-distribution property theta is arranged the perimeter of a substrate 11, and near the widely (diffusion), you may make it the luminous-intensity-distribution property theta become narrow since incidence opening of the optical plane of incidence of the lightguide which homogeneity is sufficient as the luminous-intensity-distribution property theta from a light-emitting part, and was seen from the emitter according to the circumference of a substrate 11 becomes narrow. The light which carried out outgoing radiation from such light source components 10 is equal to the diffusing-surface light source in false in the optical plane of incidence of lightguide 14. Therefore, the light which carries out outgoing radiation turns into efficient and uniform illumination light from this lightguide 14.
[0011] As shown in drawing 1 (B), lightguide (kaleidoscope) 14 has the optical plane of incidence 15 and the optical outgoing radiation side 16 where area is bigger than this optical plane of incidence 15, and, as for the wall which forms the hollow formed between the optical plane of incidence 15 and the optical outgoing radiation side 16, has reflexibility. That is, lightguide 14 has the shape of an abbreviation cartridge of the configuration which surrounds space with the four reflecting mirrors 17a, 17b, 17c, and 17d of trapezoidal shape, and the optical plane of incidence 15 and the optical outgoing radiation side 16 are analogs, and it is a rectangle again.
[0012] Drawing 1 (C) is shown in order to explain the lighting principle of lightguide 14. Lightguide 14 shall build the condition of having surrounded the periphery edge by the mirror without the clearance, outside [effective] a periphery edge and an illuminated field (it corresponds to the optical outgoing radiation side 16 or a liquid crystal display panel) outside [effective] the diffusing-surface light source section 20 (it corresponds to the optical plane of incidence 15). If the light source section 20 side is seen from the center section P of the optical outgoing radiation side 16, a mirror image 22 will be located in a line on the circle S of a radius r centering on the intersection 0 of the inside of lightguide 14. Moreover, even if it sees the light source section 20 side from the edge Q of the optical outgoing radiation side 16 of lightguide 14, the mirror image of the light source section 20 exists on the above-mentioned circle S. Therefore, an efficient and uniform illumination-light study system can be obtained by using lightguide 14.
[0013] Drawing 2 is the overall example of a configuration of the projection mold display which used the above-mentioned lighting system. As light source components, the light source components 10R, 10G, and 10B used for each image of R (red), G (green), and B (blue) are prepared. Moreover, the lightguides 14R, 14G, and 14B which the optical plane of incidence is made to counter, respectively are formed to each light source components 10R, 10G, and 10B. Furthermore, the liquid crystal display panels 30R, 30G, and 30B are formed in each optical outgoing radiation side side of lightguides 14R, 14G, and 14B, respectively. The optical image by which outgoing radiation was carried out from each liquid crystal display panels 30R, 30G, and 30B is led to the synthetic prism (dichroic prism) 31, and is compounded, and outgoing radiation is carried out in common towards the projection lens section 33. The color optical image by

which outgoing radiation was carried out from the projection lens section 33 is projected on a screen 34. In the drawing, since it is easy, the polarizing plate is omitted.
[0014] This invention is not limited to the gestalt of the above-mentioned operation, and various deformation is possible for it.
[0015] The important section in the gestalt of various kinds of operations of this invention is shown in drawing 3 (A) thru/or drawing 3 (D). The same sign is given to each part article of the gestalt of previous operation, and corresponding components. The substrate 11 is curving, and the gestalt of operation of drawing 3 (A) is constituted so that it may be easy to condense the light from each light emitting device section 19 to the optical plane of incidence 15 of lightguide 14. That is, the sense of the outgoing radiation light of each light emitting device section 19 is turned to the optical plane of incidence 15. The luminous-intensity-distribution property of the light emitting device section 19 is the include angle theta of arbitration. If it does in this way, even if it creates the outside configuration of the mold member 13 uniformly, the light from the light emitting device section 19 can be efficiently led to the optical plane of incidence 15.
[0016] The gestalt of operation of drawing 3 (B) is the example constituted so that it might have the same effectiveness as the gestalt of operation shown in drawing 3 (A) combining two or more flat-surface substrates 11a, 11c, and 11c. The light emitting device section 19 is formed in each substrates 11a, 11c, and 11c. Central flat-surface substrate 11b counters the optical plane of incidence 15 from a transverse plane, it inclines and other substrates 11a and 11c are carried out, although the optical plane of incidence 15 is turned to.
[0017] Drawing 3 (C) is the example which used the parabolic mirror 40. With the gestalt of old operation, the light-emitting part article 10 is arranged so that the light emitting device section 19 may turn to the optical plane-of-incidence 15 side directly. However, as for the gestalt of this operation, the parabolic mirror 40 has met the optical plane of incidence 15. And the light-emitting part article 10 is arranged so that each light emitting device section 19 of the light-emitting part article 10 may turn to a parabolic mirror 40. As for the example of drawing 3 (C), the light emitting device section 19 is located in the perimeter of an outside of the edge of the optical plane of incidence 15. And the chief ray of the outgoing radiation light from the light emitting device section 19 is irradiated by an optical axis and abbreviation parallel at a parabolic mirror 40. Then, the reflected light condenses to the optical plane of incidence 15 of lightguide 14.
[0018] The gestalt of operation of drawing 3 (D) is the example which carried out the additional array of two or more light emitting device sections 19 also in the center section (area which counters plane of incidence 15 and directly) of the parabolic mirror 40 in addition to the gestalt of operation of drawing 3 (C).
[0019] Furthermore, drawing 4 (A) thru/or drawing 4 (C) show the important section in the gestalt of other operations of this invention. The same sign is given to each part article of the gestalt of previous operation, and corresponding components. The gestalt of operation of drawing 4 (A) has attached the concave mirror 41 in the periphery of the optical plane of incidence 15 of lightguide 14. Moreover, the convex mirror 42 which turns to the optical plane of incidence 15 further the light reflected with the concave mirror 41, and is reflected is arranged. This convex mirror 42 is located in the center of the light source components 10, and although not illustrated, it is supported at the tip of the ****** components which it was fixed to the substrate 11 of the light source components 10, for example, and were projected. The light source components 10 are arranged so that the substrate 11 may counter in parallel to the optical plane of incidence 15. It is reflected with a concave mirror 41, and then is reflected in a convex mirror 42, and incidence of the light which carried out outgoing radiation from the light emitting device section 19 of the light source components 10 is carried out to the optical plane of incidence 15.
[0020] With the gestalt of operation of drawing 4 (B), the light source components 10 have the large luminous-intensity-distribution property which is not not much narrow as for directivity. Therefore, there is also light which does not carry out incidence to the optical plane of incidence 15. Then, the light source components 10 are arranged on the field 45 which has a high reflection property. It reflects in a reflector 45 and incidence of the light diffused from the light source components 10 is carried out to the optical plane of incidence 15. Thereby, the use

effectiveness of light increases.
[0021] The arrangement of the light source components 10 of the gestalt of operation of drawing 4 (C) is the same as that of the gestalt of operation of previous drawing 3 (C). However, with the gestalt of this operation, the reflective members 46 and 47 formed in the paraboloid by glass material are arranged to the duplex so that the light source components 10 and the optical plane of incidence 15 may be countered. The focal distance f2 of the outside reflective member 47 is set up for a long time rather than the focal distance f1 of the inside reflective member 46 here. Moreover, it is constituted so that coating of the polarization demarcation membrane 461 is carried out to the inside reflective member 46, S polarization light is reflected, and P polarization light may be made to penetrate, coating of the reflective film 471 may be carried out to the outside reflective member and P polarization light may be reflected. Moreover, lambda / 2 phase-contrast plate 146 is formed in the inside around the optical plane of incidence of lightguide 14 as a polarization conversion optical element which pushed out toward the inside. The hole of a concentric circle form is prepared on the optical axis, S polarization light passes through this hole, and P polarization light passes lambda / 2 phase-contrast plate 146, and is changed into S polarization light 147.
[0022] Although P polarization light is arranged with S polarization light, S polarization light is changed into P polarization light, and you may make it arrange it in this example. It opts for this selection according to the polarization direction of the liquid crystal display panel arranged at the optical outgoing radiation side of lightguide 14.
[0023] Drawing 5 (A) thru/or (C) show the important section in the gestalt of other operations of this invention further. The same sign is given to each part article of the gestalt of previous operation, and corresponding components. He is trying for the gestalt of operation of drawing 5 (A) to enclose further between the substrates 11 and the optical plane of incidence of lightguide 14 which have two or more light emitting devices with the fill-in flash guide 51. The configuration of this fill-in flash guide 51 is also formed so that one opening may agree on the periphery of a substrate 11 and opening of another side may agree in the optical plane of incidence of the fill-in flash guide 51. And the wall of this fill-in flash guide 51 also has reflexibility. The fill-in flash guide 51 is constituted using the mirror. The light from the light source components 10 side can be efficiently led to the optical plane of incidence 15 as it is this configuration.
[0024] The gestalt of operation of drawing 5 (B) is a configuration which surrounds one or more of the light emitting diode 12 formed in the substrate 11 by opening by the side of the optical plane of incidence of the small lightguide 52, and arranges the optical outgoing radiation side of this small lightguide to the optical plane of incidence of the Maine lightguide 14. The luminous-intensity-distribution property in this case can be found from the plane-of-incidence aperture and outgoing radiation side aperture of the small lightguide 52. The sum of the area of the optical outgoing radiation side aperture of two or more [here] small lightguides 52 becomes equal to the area of the optical plane-of-incidence aperture of the Maine lightguide 14. Moreover, if the inside of light emitting diode 12 and the small lightguide 52 is covered by the mold member, its use effectiveness of light will improve further.
[0025] The gestalt of operation of drawing 5 (C) is a configuration which one or more of the light emitting diode 12 formed in the substrate 11 are made to counter the optical plane of incidence of the optical rod lens 52, and arranges the optical outgoing radiation side of this optical rod lens 52 to the optical plane of incidence of the Maine lightguide 14. The same effectiveness as the gestalt of operation mentioned above also in this case can be acquired.
[0026] Drawing 6 is a basic configuration in the important section of the gestalt of other operations of this invention further. Although the gestalt of this operation is similar with the gestalt of operation shown in drawing 1 (C), the points which arrange the condenser lens 62 for making a chief ray 61 parallel at the optical outgoing radiation side side of lightguide 14 at an optical axis differ. Therefore, explanation of the part which gives the same sign to the part which is common in drawing 1 (C), and is common is omitted. If there is no condenser lens 62, the chief ray of the illumination light is emitted at the edge of lightguide 14. The liquid crystal panel of a projection mold display tends to receive effect in contrast or an angle of visibility according to the direction of a beam of light. Then, an angle of visibility will also be stabilized by arranging a

condenser lens 62 and making contrast into homogeneity in a stationary location.
[0027] Drawing 7 (A) thru/or (C) show the important section in the gestalt of other operations of this invention further. The same sign is given to each part article of the gestalt of previous operation, and corresponding components.
[0028] two or more emitters 12 (light emitting diode) with which the gestalt of operation of drawing 7 (A) was covered with the respectively transparent mold member 13 at the spherical-surface (conical surface) side of substrate (attachment component) 11A which has the spherical surface or the field of a cone form -- arranging -- the optical plane-of-incidence interpolation close of lightguide 14 -- it is carrying out. Although one substrate 11A is shown by a diagram, it is good also considering the substrate of such structure as plurality. Moreover, you may be a substrate not only a solid sphere but rotation elliptical. Also in the gestalt of this operation, the same effectiveness as the gestalt of previous operation can be acquired.
[0029] The gestalt of operation of drawing 7 (B) has combined two or more substrates 11, for example, constitutes them on a trapezoid. And the protrusion side is inserted in the back by the side of the optical plane of incidence of lightguide 14. Two or more emitters 12 (light emitting diode) covered with two or more transparent mold members 13 are formed in the field inside the lightguide 14 of each substrate 11.
[0030] Also in the gestalt of this operation, the same effectiveness as the gestalt of previous operation can be acquired.
[0031] The perimeter of light emitting diode 12 is covered with a mold member, the gestalt of operation of drawing 7 (C) is formed in a plane, and the micro lens is arranged.
[0032] The semiconducting crystal used for light emitting diode 12 has about about 3.5 high refractive index. Therefore, from the refractive index of a medium until it contacts into atmospheric air from a semiconducting crystal, the ejection effectiveness of light is decided by the critical angle which can be found. The critical angle of the light at the time of setting in atmospheric air is about about 16 degrees, and the use effectiveness of light is bad. If a micro lens (it considers as a refractive index N= 1.5) is arranged on a semiconducting crystal, a critical angle will become about 25 degrees. Outgoing radiation of the light near the critical angle is carried out almost at right angles to an optical axis. (It will be reflected even if it arrives at an interface with atmospheric air as it is.) By the micro lens, by being refracted in the direction parallel to an optical axis, it becomes easy to carry out outgoing radiation into atmospheric air, and the use effectiveness of light improves. Moreover, the mold member may be caught between light emitting diode 12 and a micro lens, and the same effectiveness is acquired even if the medium for adhesion is caught. The lens and emitter of a micro lens may correspond by 1 to 1, may correspond by one-pair plurality, and may correspond by two or more to 1.
[0033]
[Effect of the Invention] As explained above, while improving efficiency for light utilization further according to this invention, a low power, reduction of generation of heat, and a lightweight miniaturization can be obtained.

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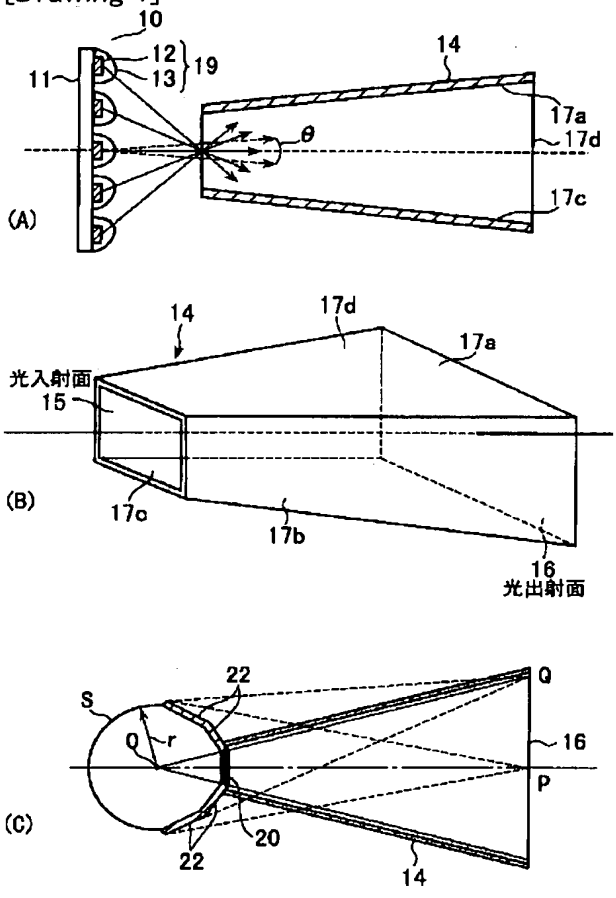
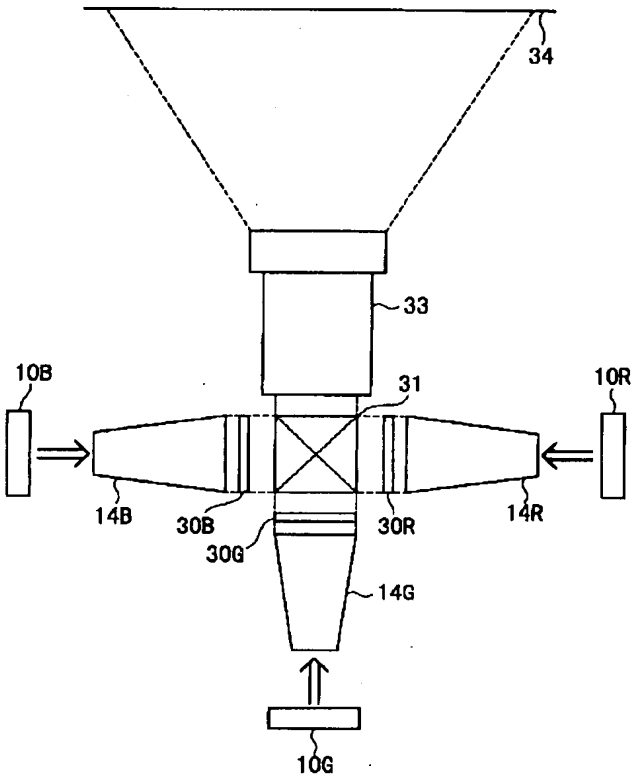
DRAWINGS

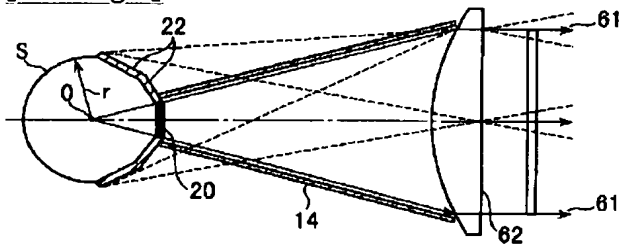
[Drawing 1]



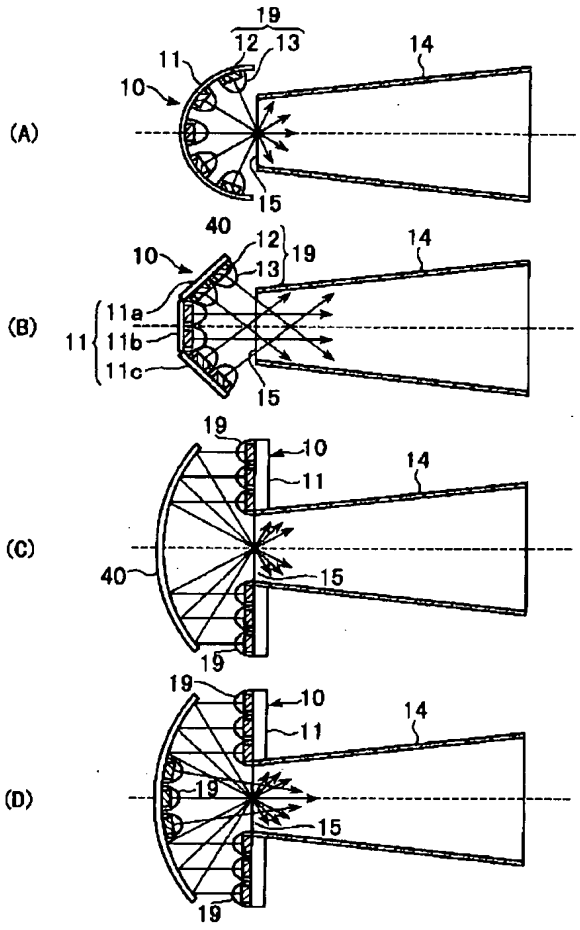
[Drawing 2]



[Drawing 6]



[Drawing 3]


(A)
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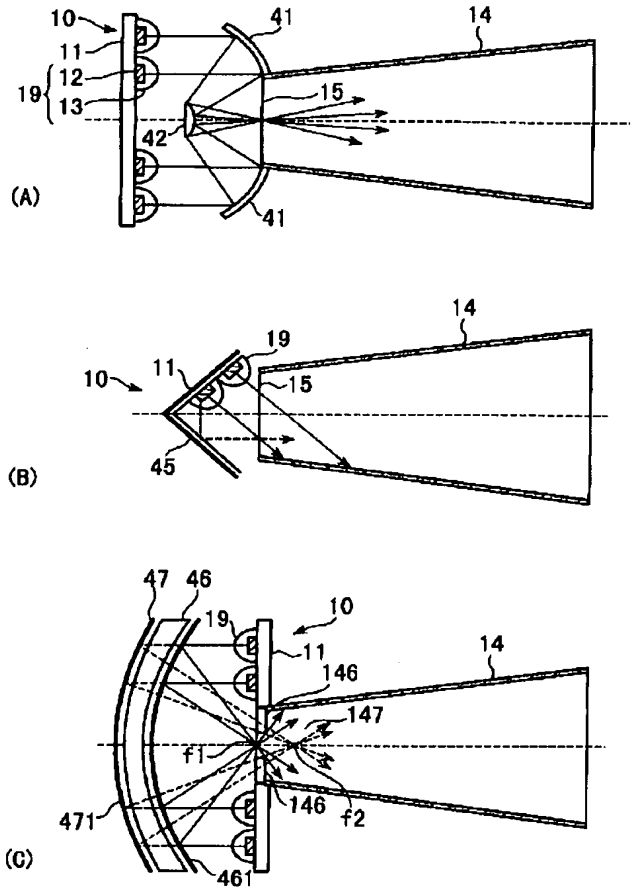
[Drawing 4]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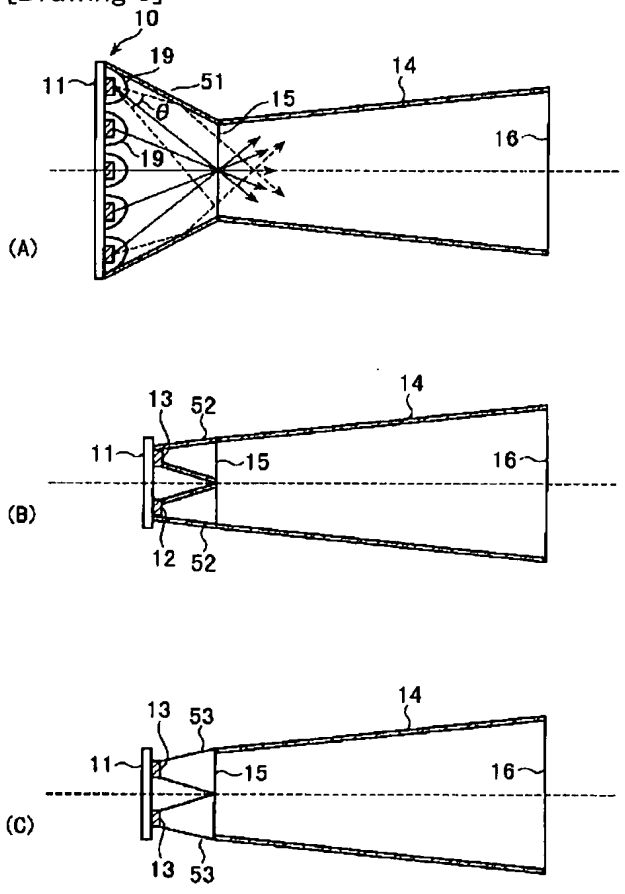
[Drawing 5]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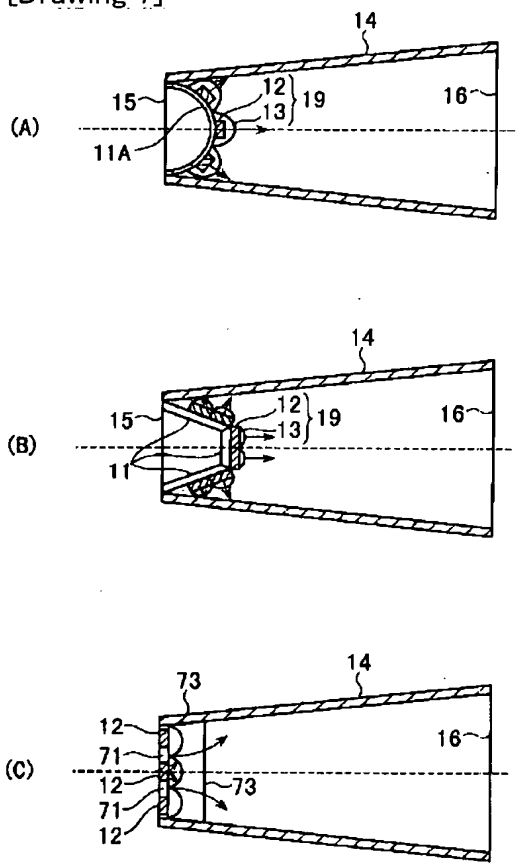
[Drawing 7]



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